

RECLAMATION

Managing Water in the West

Transmission System Modeling and Simulation



U.S. Department of the Interior
Bureau of Reclamation

Denver Technical Service Center

- **Organizational Structure:**
 - Reclamation uses a centralized testing team from the Denver Technical Service Center (TSC).
- **Capability of Staff:**
 - Electrical Engineers with several years of experience.
- **Training:**
 - Post-graduate training in Power System Dynamics, Feedback Control Systems, and training from original equipment suppliers on specific equipment.

Transmission System Modeling and Simulation

- **Steady-state and Dynamic Modeling and Simulation of the Interconnected Transmission System:**
 - Reclamation has not contracted this work out.
 - All work is performed with in-house forces.
 - Reclamation offers this service to other government agencies.

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In-House Testing

- **Capability of Existing Staff:**
 - Our testing team consists of four people who work on excitation and governor control systems full-time.
- **Skills Needed:**
 - Participates in research and development, initial commissioning, troubleshoots, repairs, and tunes excitation and governor control systems.
 - Proficient in power generation, electric power systems, and control theory, as well as instrumentation, electronics, and application of digital controllers.
- **Training Needed:**
 - Formal education with focus on power engineering and control theory.
 - Several years of on-the-job training.

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In-House Testing

- **Special Test Equipment:**
 - Testing/troubleshooting requires atypical equipment and methods. Finding suitable off-the-shelf equipment is challenging.
 - Our current equipment is a combination of specialized commercial equipment, modified commercial equipment, and in-house built equipment .

Reclamation Testing Program

- **Number of Units:**
 - Pacific Northwest Region - 46 units (Grand Coulee, Hungry Horse, Palisades, Minidoka, Roza, Green Springs, Anderson Ranch Powerplants).
 - Other Reclamation Regions – 150 units.
- **Number of Units Tested Each Year:**
 - 30 units per year (10-12 powerplants).

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Testing

- **Operating Data:**
 - Typical operating data is not sampled fast enough (phasor measurement unit (PMU) or power system dynamic data sampling rates are required).
 - Useful data consists largely of generator controllers dynamically responding to known inputs, with a time resolution of a few milliseconds, usually beyond the quality of operating data.

Testing

- **Model Validation Issues:**
 - Quality of validation is proportional to quality of test data.
 - Validation staff needs software tools to access test data (data acquisition, frequency response, etc.).
- **Short Cuts Used:**
 - Revalidation testing can be replaced with PMU recorded during system events (if there are enough “close” events for automatic voltage regulator validation).
- **Lessons Learned:**
 - Working with original equipment suppliers during original commissioning is helpful for reducing the time needed for subsequent tests.

How is the Test Data Used

- The test data itself is used for developing reports, i.e., model validation (by Denver TSC model validation staff).
- Model validation reports are submitted to Transmission Planners and models are submitted to the Western Electricity Coordinating Council (WECC) for the database:
 - Transmission Planners review reports and test the models to determine if they are acceptable. The data is used for studies to determine power system transfer capabilities, etc.

WECC Variances of the Standards

- Existing WECC policy is more stringent than the North American Electric Reliability Corporation MOD-026 and MOD-027.
- WECC Modeling and Validation Work Group does not recommend withdrawing the existing policy, which would require a variance to the standards.

- Questions?

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